09/980,375

Copy for the Elected Office (EO/US)

PCT/IL99/00288

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF THE RECORDING OF A CHANGE

(PCT Rule 92bis.1 and Administrative Instructions, Section 422)

To:

FENSTER, Paul
Fenster & Company Patent Attorneys, Ltd.
P.O. Box 10256
49002 Petach Tikva
ISRAËL

Date of mailing (day/month/year) 12 September 2001 (12.09.01)	
Applicant's or agent's file reference 013/00975	**IMPORTANT NOTIFICATION**
International application No. PCT/IL99/00288	**International filing date** (day/month/year) 31 May 1999 (31.05.99)

1. The following indications appeared on record concerning:

[X] the applicant [X] the inventor [ ] the agent [ ] the common representative

Name and Address	State of Nationality	State of Residence
	Telephone No.	
	Facsimile No.	
	Teleprinter No.	

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

[X] the person [ ] the name [ ] the address [ ] the nationality [ ] the residence

Name and Address	State of Nationality	State of Residence
KARASIKOV, Nir 49 Hague Street 34980 Haifa Israel	IL	IL
	Telephone No.	
	Facsimile No.	
	Teleprinter No.	

3. Further observations, if necessary:
Additional applicant/inventor for US only. He shoud follow SHIV, Lior.

4. A copy of this notification has been sent to:

[X] the receiving Office
[ ] the International Searching Authority
[ ] the International Preliminary Examining Authority
[ ] the designated Offices concerned
[X] the elected Offices concerned
[ ] other:

The International Bureau of WIPO **34, chemin des Colombettes** **1211 Geneva 20, Switzerland**	Authorized officer Marie-José DEVILLARD
Facsimile No.: (41-22) 740.14.35	Telephone No.: (41-22) 338.83.38

Form PCT/IB/306 (March 1994)

004276494

Copy for the Elected Office (EO/US)

PCT/IL99/00288

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF THE RECORDING OF A CHANGE

(PCT Rule 92bis.1 and Administrative Instructions, Section 422)

To:

FENSTER, Paul
Fenster & Company Patent
Attorneys, Ltd.
P.O. Box 10256
49002 Petach Tikva
ISRAËL

Date of mailing (day/month/year)
12 September 2001 (12.09.01)

Applicant's or agent's file reference
013/00975

IMPORTANT NOTIFICATION

International application No.
PCT/IL99/00288

International filing date (day/month/year)
31 May 1999 (31.05.99)

1. The following indications appeared on record concerning:

[X] the applicant [X] the inventor [ ] the agent [ ] the common representative

Name and Address

State of Nationality | State of Residence

Telephone No.

Facsimile No.

Teleprinter No.

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

[X] the person [ ] the name [ ] the address [ ] the nationality [ ] the residence

Name and Address

GANOR, Ze'ev
13 Ben Shalom Street
46408 Herzeliya
Israel

State of Nationality: IL | State of Residence: IL

Telephone No.

Facsimile No.

Teleprinter No.

3. Further observations, if necessary:

Additional applicant/inventor for US only. He should precede RAFAELI, Izhak.

4. A copy of this notification has been sent to:

[X] the receiving Office
[ ] the International Searching Authority
[ ] the International Preliminary Examining Authority
[ ] the designated Offices concerned
[X] the elected Offices concerned
[ ] other:

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No.: (41-22) 740.14.35

Authorized officer

Marie-José DEVILLARD

Telephone No.: (41-22) 338.83.38

Form PCT/IB/306 (March 1994)

004276493

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

To:

Commissioner
US Department of Commerce
United States Patent and Trademark
Office, PCT
2011 South Clark Place Room
CP2/5C24
Arlington, VA 22202
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

Date of mailing: 07 December 2000 (07.12.00)	
International application No.: PCT/IL99/00288	Applicant's or agent's file reference: 013/00975
International filing date: 31 May 1999 (31.05.99)	Priority date:
Applicant: RAFAELI, Izhak et al	

1. The designated Office is hereby notified of its election made:

[X] in the demand filed with the International preliminary Examining Authority on:

07 May 2000 (07.05.00)

[ ] in a notice effecting later election filed with the International Bureau on:

2. The election [X] was

[ ] was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO **34, chemin des Colombettes** **1211 Geneva 20, Switzerland**	Authorized officer: J. Zahra
Facsimile No.: (41-22) 740.14.35	Telephone No.: (41-22) 338.83.38

Form PCT/IB/331 (July 1992)

3692206

PATENT COOPERATION TREATY

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:

Fenster,P.
FENSTER & COMPANY PATENT
ATTORNEYS, LTD
P.O.Box 10256
Petach Tikva 49002
ISRAEL

PCT

NOTIFICATION OF TRANSMITTAL OF
THE INTERNATIONAL PRELIMINARY
EXAMINATION REPORT
(PCT Rule 71.1)

Date of mailing *(day/month/year)*	22.09.2000
Applicant's or agent's file reference 013/00975	**IMPORTANT NOTIFICATION**

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/IL99/00288	31/05/1999	31/05/1999

Applicant
NANOMOTION LTD. et al.

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.

2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.

3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. **REMINDER**

   The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

   Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

   For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

Name and mailing address of the IPEA/	Authorized officer
European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Schuster-Kaechele, W Tel.+49 89 2399-2281

Form PCT/IPEA/416 (July 1992)

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
013/00975		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/IL99/00288	31/05/1999	31/05/1999
International Patent Classification (IPC) or national classification and IPC H01L41		
Applicant NANOMOTION LTD. et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 8 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of fourteen sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☒ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations suporting such statement
   - VI ☐ Certain documents cited
   - VII ☐ Certain defects in the international application
   - VIII ☒ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
07/05/2000	22.09.2000
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Korb, W Telephone No. +49 89 2399 2284

Form PCT/IPEA/409 (cover sheet) (January 1994)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/IL99/00288

I. Basis of the report

1. This report has been drawn on the basis of (*substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.*):

Description, pages:

1-24 as originally filed

Claims, No.:

1-42 with telefax of 31/07/2000

Drawings, sheets:

1/10-10/10 as originally filed

2. The amendments have resulted in the cancellation of:

☐ the description, pages:
☐ the claims, Nos.:
☐ the drawings, sheets:

3. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

4. Additional observations, if necessary:

IV. Lack of unity of invention

1. In response to the invitation to restrict or pay additional fees the applicant has:

☐ restricted the claims.

☒ paid additional fees.

☐ paid additional fees under protest.

☐ neither restricted nor paid additional fees.

2. ☐ This Authority found that the requirement of unity of invention is not complied and chose, according to Rule 68.1, not to invite the applicant to restrict or pay additional fees.

3. This Authority considers that the requirement of unity of invention in accordance with Rules 13.1, 13.2 and 13.3 is

   ☐ complied with.

   ☒ not complied with for the following reasons:

   see separate sheet

4. Consequently, the following parts of the international application were the subject of international preliminary examination in establishing this report:

   ☐ all parts.

   ☒ the parts relating to claims Nos. 1 - 42.

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1 - 42
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1 - 42
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1 - 42
	No:	Claims	

2. Citations and explanations

   see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

Re Item IV

Lack of unity of invention

The present application contains two independent claims (claims 1 and 32) which have been found to be not so so linked as to form a single general inventive concept (Rule 13.1 PCT) for the following reasons:

The method according to claim 32 does not necessarily require a piezoelectric micromotor of the type claimed in claim 1 and the piezoelectric micromotor is not interrelated with the method in that its application is not necessarily limited thereto.

Re Item V

Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Reference is made to the following documents:

   D1: EP-A-0 633 616 (NANOMOTION LTD) 11 January 1995 (1995-01-11) cited in the application

   D2: EP-A-0 536 832 (PHILIPS PATENTVERWALTUNG ;PHILIPS NV (NL)) 14 April 1993 (1993-04-14)

2. There is no doubt in regard of the possibility of an industrial applicability of the subject-matter claimed in claims 1 - 31.

   Furthermore the subject-matter of Claim 1 is considered to be new and to involve an inventive step with respect to the available documents cited in the International Search Report and representing a state of the art according to Rule 64(1) PCT.

   The dependent claims 2 - 31 refer to claim 1 directly or indirectly and meet the requirements for such claims with regard to novelty and inventive step.

3. The subject-matter of claim 1 of the present application is related to piezoelectric micromotor comprising a vibrator in the shape of a rectangular parallelepiped

formed from a plurality of thin piezoelectric layers aligned one on top of the other and having their face surfaces bonded together. The electrode configuration of the vibrator is suitable for exciting transverse vibrations, so that a coupling region of the motor can be moved parallel to an edge surface on which the coupling region is located.

The problem to be solved is to provide a high power, low voltage piezoelectric micromotor allowing improved control of motion which it imparts to a body it moves during "start up" and positioning of the body.

In contrast to the piezoelectric micromotor according to claim 1 the piezoelectric motors described in D2, both the bimorph motor and the rotary motor, operate in a bending mode only in which longitudinal vibrations are combined with bending vibrations, which are perpendicular to the plane of the motors, to impart motion to a moveable element. Neither of the motors known from D2 is exited to vibrate in a transverse vibration mode, or comprises an electrode configuration suitable for exciting transverse vibrations.

With respect to document D1 it has to be noted that the limitation to layers which "are aligned one on top of the other and have their face surfaces bonded together" is not taught or implied by D1. D1 even teaches away from bonded layers. To increase power D1 teaches (column 11, lines 19 - 52) mounting a plurality of piezoelectric plates either in tandem and/or in parallel by mounting the plates in appropriate frames, which are referred to as "spacers". As shown in Figs. 6 and 7 of D1, the spacers keep the plates from direct contact with each other. In column 11, lines 40 - 45 D1 notes that the plates are also constrained from moving perpendicular to their faces, preferably "by extensions of spacer unit 74 ...". These extensions are clearly visible in Fig, 7 of D1 and are shown separating the plates.

In consequence the subject-matter of claim 1 is considered to be novel and non-obvious over the disclosure of documents D1 and D2, with regard to inventive step either standing alone or in combination.

4. There is no doubt in regard of the possibility of an industrial applicability of the

subject-matter claimed in claims 32 - 42.

Furthermore the subject-matter of Claim 32, insofar as the present text can be understood with the help of the description, is considered to be new and to involve an inventive step with respect to the available documents cited in the International Search Report and representing a state of the art according to Rule 64(1) PCT, if the defects of this claim can be removed by suitable amendments.
The dependent claims 33 - 42 refer to claim 32 directly or indirectly and meet the requirements for such claims with regard to novelty and inventive step.

5. The subject-matter of claim 32 is related to a method for accelerating or decelerating a movable body moved by a piezoelectric micromotor in which vibrations having a first amplitude in a first direction and a second amplitude in a second direction perpendicular to the first direction are exited. Acceleration or deceleration is achieved by gradually changing a ratio between the second amplitude relative to the first amplitude.

The problem to be solved is to accurately control acceleration or deceleration of the body.

In document D1 longitudinal and transverse vibration modes and in document D2 longitudinal and transverse bending vibration modes are used to transmit motion from a piezoelectric motor to a moveable body to which the motor is coupled. Neither of these documents teaches varying the amplitude of one of the vibration modes used to move the body with respect to the other of the vibration motes. In particular neither of these documents teaches varying one of the amplitudes with respect to the other to achieve gradual and accurately controlled acceleration or deceleration of the body.

Document D1 recognizes a need for fine control of motion of a movable e body driven by a piezoelectric motor when accelerating the body from rest and when decelerating the body to rest. In a discussion in column 8, line 56 to column 10, line 57, D1 describes bringing a body that is driven by a piezoelectric motor to rest by switching operation of the motor from a vibratory mode driven by an AC voltage to a pulsed mode of operation in which electrodes of the motor are pulsed with DC

voltages. In column 12, lines 1 - 29, D1 describes using vibrators formed from different types of piezoelectric materials to achieve "smoother more accurate motion with smoother stops and starts" (column 12, lines 27 - 28). Document D1 therefore, does not teach or imply achieving, gradual, smooth acceleration of a body driven by a piezoelectric motor by modifying relative amplitudes of vibratory modes of the motor that are normally used to drive the body. D1 in fact teaches away from such means of achieving gradual acceleration and teaches abandoning "normal" vibratory motion in favour of a pulsed mode of operation or using a combination of different piezoelectric materials to achieve gradual acceleration. The extended discussion in D1 of means for achieving gradual acceleration has also to be considered as being witness that such controlled acceleration is not a trivial matter when switching a piezoelectric motor on or off.

With regard to document D2 it has to be noted that an embodiment of the invention described therein may be driven by pulses of voltage and that the pulses may have different amplitudes and rise times (see the remark made on page 2, lines 27 - 29). However this driving possibility of D2 is not disclosed in relation with accelerating or decelerating a body moved by the piezoelectric motors described. Document D2 does not address controlling acceleration and is completely silent about the problem to be solved of to accurately controlling acceleration or deceleration of the body.

In the light of the above the subject-matter of claim 32, in as much as it is rendered clear (see item VIII below), is considered to be novel and non-obvious over the disclosure of the presently available prior art documents D1 and D2, with regard to inventive step either standing alone or in combination.

Re Item VII

Certain defects in the international application

1. Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in the documents D1 and 2 is not mentioned in the description, nor are these documents identified therein.

2. The features of the claims are not provided with reference signs placed in parentheses (Rule 6.2(b) PCT).

Re Item VIII

Certain observations on the international application

1. In claim 32 "the" second direction is not defined in a preceding portion of the claim. The present formulation "which body is moved by urging a piezoelectric micromotor to the body in a first direction" together with "exiting vibrations ... in the first direction and in the direction of motion" may give the impression that the first direction is identical with the direction of motion.

   Furthermore the essential feature that the second direction is perpendicular to the first direction which was present in both original independent claims 32 and 43 has been omitted from valid independent claim 32.

   It should also be noted that the description does not support other directions than a perpendicular direction with regard to the first and second direction. In consequence present claim 32 not only does not meet the requirements of Article 6 PCT but also contravenes the requirements of Article 34 (2) PCT.

2. The verbs indicated in the statement in the description at page 24, lines 3 - 6 have a well recognized meaning. Thus the intention of this vague and imprecise statement ("in the description and claims of the present application the verbs ...") cannot be understood. It would therefore appear that this statement implies that the subject-matter for which protection is sought may be different to that defined by the claims, thereby resulting in lack of clarity (Article 6 PCT) when used to interpret them (see also the PCT Guidelines, III-4.3a).

PATENT COOPERATION TREATY

PCT

REC'D 26 SEP 2000
WIPO PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
013/00975		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/IL99/00288	31/05/1999	31/05/1999
International Patent Classification (IPC) or national classification and IPC		
H01L41		
Applicant		
NANOMOTION LTD. et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 8 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of ~~fourteen~~ 15 sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☒ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations suporting such statement
   - VI ☐ Certain documents cited
   - VII ☐ Certain defects in the international application
   - VIII ☒ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
07/05/2000	22.09.2000
Name and mailing address of the international preliminary examining authority:	Authorized officer
European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Korb, W Telephone No. +49 89 2399 2284

Form PCT/IPEA/409 (cover sheet) (January 1994)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/IL99/00288

I. Basis of the report

1. This report has been drawn on the basis of (*substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.*):

Description, pages:

1-24 as originally filed

Claims, No.:

1-42 with telefax of 31/07/2000

Drawings, sheets:

1/10-10/10 as originally filed

2. The amendments have resulted in the cancellation of:

☐ the description, pages:
☐ the claims, Nos.:
☐ the drawings, sheets:

3. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

4. Additional observations, if necessary:

IV. Lack of unity of invention

1. In response to the invitation to restrict or pay additional fees the applicant has:

☐ restricted the claims.

☒ paid additional fees.

☐ paid additional fees under protest.

☐ neither restricted nor paid additional fees.

2. ☐ This Authority found that the requirement of unity of invention is not complied and chose, according to Rule 68.1, not to invite the applicant to restrict or pay additional fees.

3. This Authority considers that the requirement of unity of invention in accordance with Rules 13.1, 13.2 and 13.3 is

   ☐ complied with.

   ☒ not complied with for the following reasons:

see separate sheet

4. Consequently, the following parts of the international application were the subject of international preliminary examination in establishing this report:

   ☐ all parts.

   ☒ the parts relating to claims Nos. 1 - 42.

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims 1 - 42
	No:	Claims
Inventive step (IS)	Yes:	Claims 1 - 42
	No:	Claims
Industrial applicability (IA)	Yes:	Claims 1 - 42
	No:	Claims

2. Citations and explanations

see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

Re Item IV
Lack of unity of invention

The present application contains two independent claims (claims 1 and 32) which have been found to be not so so linked as to form a single general inventive concept (Rule 13.1 PCT) for the following reasons:

The method according to claim 32 does not necessarily require a piezoelectric micromotor of the type claimed in claim 1 and the piezoelectric micromotor is not interrelated with the method in that its application is not necessarily limited thereto.

Re Item V
Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Reference is made to the following documents:

   D1: EP-A-0 633 616 (NANOMOTION LTD) 11 January 1995 (1995-01-11) cited in the application
   D2: EP-A-0 536 832 (PHILIPS PATENTVERWALTUNG ;PHILIPS NV (NL)) 14 April 1993 (1993-04-14)

2. There is no doubt in regard of the possibility of an industrial applicability of the subject-matter claimed in claims 1 - 31.

   Furthermore the subject-matter of Claim 1 is considered to be new and to involve an inventive step with respect to the available documents cited in the International Search Report and representing a state of the art according to Rule 64(1) PCT.

   The dependent claims 2 - 31 refer to claim 1 directly or indirectly and meet the requirements for such claims with regard to novelty and inventive step.

3. The subject-matter of claim 1 of the present application is related to piezoelectric micromotor comprising a vibrator in the shape of a rectangular parallelepiped

formed from a plurality of thin piezoelectric layers aligned one on top of the other and having their face surfaces bonded together. The electrode configuration of the vibrator is suitable for exciting transverse vibrations, so that a coupling region of the motor can be moved parallel to an edge surface on which the coupling region is located.

The problem to be solved is to provide a high power, low voltage piezoelectric micromotor allowing improved control of motion which it imparts to a body it moves during "start up" and positioning of the body.

In contrast to the piezoelectric micromotor according to claim 1 the piezoelectric motors described in D2, both the bimorph motor and the rotary motor, operate in a bending mode only in which longitudinal vibrations are combined with bending vibrations, which are perpendicular to the plane of the motors, to impart motion to a moveable element. Neither of the motors known from D2 is exited to vibrate in a transverse vibration mode, or comprises an electrode configuration suitable for exciting transverse vibrations.

With respect to document D1 it has to be noted that the limitation to layers which "are aligned one on top of the other and have their face surfaces bonded together" is not taught or implied by D1. D1 even teaches away from bonded layers. To increase power D1 teaches (column 11, lines 19 - 52) mounting a plurality of piezoelectric plates either in tandem and/or in parallel by mounting the plates in appropriate frames, which are referred to as "spacers". As shown in Figs. 6 and 7 of D1, the spacers keep the plates from direct contact with each other. In column 11, lines 40 - 45 D1 notes that the plates are also constrained from moving perpendicular to their faces, preferably "by extensions of spacer unit 74 ...". These extensions are clearly visible in Fig, 7 of D1 and are shown separating the plates.

In consequence the subject-matter of claim 1 is considered to be novel and non-obvious over the disclosure of documents D1 and D2, with regard to inventive step either standing alone or in combination.

4. There is no doubt in regard of the possibility of an industrial applicability of the

subject-matter claimed in claims 32 - 42.

Furthermore the subject-matter of Claim 32, insofar as the present text can be understood with the help of the description, is considered to be new and to involve an inventive step with respect to the available documents cited in the International Search Report and representing a state of the art according to Rule 64(1) PCT, if the defects of this claim can be removed by suitable amendments.
The dependent claims 33 - 42 refer to claim 32 directly or indirectly and meet the requirements for such claims with regard to novelty and inventive step.

5. The subject-matter of claim 32 is related to a method for accelerating or decelerating a movable body moved by a piezoelectric micromotor in which vibrations having a first amplitude in a first direction and a second amplitude in a second direction perpendicular to the first direction are exited. Acceleration or deceleration is achieved by gradually changing a ratio between the second amplitude relative to the first amplitude.

The problem to be solved is to accurately control acceleration or deceleration of the body.

In document D1 longitudinal and transverse vibration modes and in document D2 longitudinal and transverse bending vibration modes are used to transmit motion from a piezoelectric motor to a moveable body to which the motor is coupled. Neither of these documents teaches varying the amplitude of one of the vibration modes used to move the body with respect to the other of the vibration motes. In particular neither of these documents teaches varying one of the amplitudes with respect to the other to achieve gradual and accurately controlled acceleration or deceleration of the body.

Document D1 recognizes a need for fine control of motion of a movable e body driven by a piezoelectric motor when accelerating the body from rest and when decelerating the body to rest. In a discussion in column 8, line 56 to column 10, line 57, D1 describes bringing a body that is driven by a piezoelectric motor to rest by switching operation of the motor from a vibratory mode driven by an AC voltage to a pulsed mode of operation in which electrodes of the motor are pulsed with DC

voltages. In column 12, lines 1 - 29, D1 describes using vibrators formed from different types of piezoelectric materials to achieve "smoother more accurate motion with smoother stops and starts" (column 12, lines 27 - 28). Document D1 therefore, does not teach or imply achieving, gradual, smooth acceleration of a body driven by a piezoelectric motor by modifying relative amplitudes of vibratory modes of the motor that are normally used to drive the body. D1 in fact teaches away from such means of achieving gradual acceleration and teaches abandoning "normal" vibratory motion in favour of a pulsed mode of operation or using a combination of different piezoelectric materials to achieve gradual acceleration. The extended discussion in D1 of means for achieving gradual acceleration has also to be considered as being witness that such controlled acceleration is not a trivial matter when switching a piezoelectric motor on or off.

With regard to document D2 it has to be noted that an embodiment of the invention described therein may be driven by pulses of voltage and that the pulses may have different amplitudes and rise times (see the remark made on page 2, lines 27 - 29). However this driving possibility of D2 is not disclosed in relation with accelerating or decelerating a body moved by the piezoelectric motors described. Document D2 does not address controlling acceleration and is completely silent about the problem to be solved of to accurately controlling acceleration or deceleration of the body.

In the light of the above the subject-matter of claim 32, in as much as it is rendered clear (see item VIII below), is considered to be novel and non-obvious over the disclosure of the presently available prior art documents D1 and D2, with regard to inventive step either standing alone or in combination.

Re Item VII

Certain defects in the international application

1. Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in the documents D1 and 2 is not mentioned in the description, nor are these documents identified therein.

2. The features of the claims are not provided with reference signs placed in parentheses (Rule 6.2(b) PCT).

Re Item VIII

Certain observations on the international application

1. In claim 32 "the" second direction is not defined in a preceding portion of the claim. The present formulation "which body is moved by urging a piezoelectric micromotor to the body in a first direction" together with "exiting vibrations ... in the first direction and in the direction of motion" may give the impression that the first direction is identical with the direction of motion.

   Furthermore the essential feature that the second direction is perpendicular to the first direction which was present in both original independent claims 32 and 43 has been omitted from valid independent claim 32.

   It should also be noted that the description does not support other directions than a perpendicular direction with regard to the first and second direction. In consequence present claim 32 not only does not meet the requirements of Article 6 PCT but also contravenes the requirements of Article 34 (2) PCT.

2. The verbs indicated in the statement in the description at page 24, lines 3 - 6 have a well recognized meaning. Thus the intention of this vague and imprecise statement ("in the description and claims of the present application the verbs ...") cannot be understood. It would therefore appear that this statement implies that the subject-matter for which protection is sought may be different to that defined by the claims, thereby resulting in lack of clarity (Article 6 PCT) when used to interpret them (see also the PCT Guidelines, III-4.3a).

CLAIMS

1. A piezoelectric micromotor for moving a moveable element comprising:

a vibrator in the shape of a rectangular parallelepiped formed from a plurality of thin layers of piezoelectric material having first and second identical relatively large rectangular face surfaces defined by long and short edge surfaces wherein the layers are aligned one on top of the other and have their face surfaces bonded together;

~~electrodes on surfaces of the layers;~~

a contact region located on one or more edge surfaces of the layers, ~~urged against the~~ body; and

a least one electrical power supply that electrifies electrodes to excite vibrations in the vibrator and thereby in the contact region that impart motion to the body;

wherein at least some of the electrodes are electrifiable to excite transverse vibrations in the vibrator, which transverse vibrations are vibrations parallel to the one or more edges of the layers on which the contact region is situated.

2. A piezoelectric micromotor according to claim 1 wherein the one or more edge surfaces are short edge surfaces of the layers.

3. A piezoelectric micromotor according to claim 1 or claim 2 and including a wear resistant element situated at the contact region for contact with the body.

4. A piezoelectric micromotor according to any of the preceding claims comprising electrodes on face surfaces of the layers that are electrifiable by an AC voltage provided by the power supply to excite elliptical vibrations in the vibrator having a controllable eccentricity.

5. A piezoelectric micromotor according to any of the preceding claims comprising:

a single large electrode on a first face surface of each layer; and

four quadrant electrodes on a second face surface of each layer wherein the quadrant electrodes are arranged in a chockerboard pattern.

6. A piezoelectric micromotor according to any of claims 1-3, comprising:

a single large electrode on a first face surface of each layer; and

a single large electrode on the second face surface of at least one but not all layers;

four quadrant electrodes on the second face surface of at least one layer, wherein the quadrant electrodes are arranged in a checkerboard pattern

7. A piezoelectric micromotor according to claim 5 wherein at least two non-contiguous face surfaces have quadrant electrodes.

8. A piezoelectric micromotor according to claim 5 wherein the at least one power supply electrifies all quadrant electrodes on the second face surface of at least one but not all the layers with a same AC voltage so as to excite longitudinal vibrations in the vibrator and thereby in the contact surface wherein longitudinal vibrations are vibrations parallel to the edges of the layers on which the contact region is situated.

9. A piezoelectric micromotor according to claim 6 wherein the power supply electrifies a large electrode on the second face surface of at least one layer with an AC voltage to excite longitudinal vibrations in the vibrator and thereby in the contact region wherein longitudinal vibrations are vibrations parallel to the edges of the layers on which the contact region is situated.

10. A piezoelectric micromotor according to claim 8 or claim 9 wherein for at least one layer the at least one power supply electrifies a first pair of diagonally disposed quadrant electrodes with a first AC voltage and a second pair of quadrant electrodes along a second diagonal with a second AC voltage and wherein the first and second AC voltages are 180^{o} out of phase and have a same magnitude, so as to excite transverse vibrations in the piezoelectric vibrator.

11. A piezoelectric motor according to claim 10 wherein the at least one layer comprises a plurality of layers and wherein homologous electrodes on different layers of the plurality of layers are electrified with the same voltage.

12. A piezoelectric motor according to claim 10 or claim 11 wherein the at least one power source controls magnitudes of AC voltages used to excite longitudinal and transverse vibrations to selectively provide different forms and amplitudes of vibratory motion of the contact region in a plane parallel to the planes of the layers.

13. A piezoelectric motor according to any of claims 10-12 wherein the at least one power source controls phases of AC voltages used to excite longitudinal and transverse vibrations to selectively provide different forms of vibratory motion of the contact region in a plane parallel to the planes of the layers.

14. A piezoelectric motor according to any of claims 10-13 wherein the at least one power source controls frequencies of AC voltages used to excite longitudinal and transverse vibrations to selectively provide different forms of vibratory motion of the contact region in a plane parallel to the planes of the layers.

15. A piezoelectric micromotor according to any of claims 8-14 wherein for at least one layer the at least one power supply electrifies a first pair of electrodes along a first short edge of the layer and a second pair of quadrant electrodes along a second short edge with first and second AC voltages respectively that are 180° out of phase and have a same magnitude, so as to excite bending vibrations perpendicular to the planes of the layers in the piezoelectric vibrator.

16. A piezoelectric motor according to claim 15 wherein the at least one layer comprises a plurality of layers.

17. A piezoelectric motor according to claim 16 wherein homologous electrodes on layers located on a same side of a face surface inside the vibrator are electrified in phase and homologous electrodes on layers located on opposite sides of the face surface are electrified 180° out of phase.

18. A piezoelectric motor according to claim 15 or claim 17 wherein the at least one power source controls magnitudes of AC voltages used to excite longitudinal and bending vibrations to selectively provide different forms and amplitudes of vibratory motion of the contact region in a plane perpendicular to the planes of the layers.

19. A piezoelectric motor according to any of claims 15-18 wherein the at least one power source controls phases of AC voltages used to excite longitudinal and bending vibrations to selectively provide different forms of vibratory motion of the contact region in a plane perpendicular to the planes of the layers.

20. A piezoelectric motor according to any of claims 15-19 wherein the at least one power source controls frequencies of AC voltages used to excite longitudinal and transverse vibrations to selectively provide different forms of vibratory motion of the contact region in a plane parallel to the planes of the layers.

21. A piezoelectric micromotor according to any of claims 5-20 wherein, for at least one layer, the at least one power supply electrifies a pair of quadrant electrodes that lie along a first diagonal of the layer with an AC voltage while a pair of quadrant electrodes along a second diagonal of the layer are grounded or floating, in order to excite elliptical vibrations in the vibrator.

22. A piezoelectric micromotor according to claim 21 wherein the at least one layer comprises a plurality of layers and wherein homologous electrodes are electrified with the same AC voltage.

23. A piezoelectric motor according to claim 21 or claim 22 wherein the at least one power supply controls the frequency of the AC voltage to selectively control the eccentricity of the elliptical motion.

24. A piezoelectric micromotor according to any of the preceding claims and comprising at least one relatively thin layer of non-piezoelectric material having large rectangular face surfaces defined by long and short edges and relatively narrow long and short edge surfaces.

25. A piezoelectric micromotor according to claim 24 wherein the one of the edges of the at least one non-piezoelectric layer are substantially equal in length to one of the corresponding edges of the piezoelectric layers.

26. A piezoelectric motor according to claim 25 wherein the one edge is a short edge.

27. A piezoelectric micromotor according to claim 25 or claim 26 wherein the other edges of the at least one non-piezoelectric layer are slightly longer than the corresponding other edges of the piezoelectric layers so that at least one edge surface of the non-piezoelectric layer protrudes from the piezoelectric layers.

28. A piezoelectric motor according to claim 27 wherein the other edge is the long edge and wherein at least one short edge surface of the non-piezoelectric layer protrudes from the piezoelectric layers.

29. A piezoelectric micromotor according to claim 27 or claim 28 wherein the contact region comprises a region of one of the at least one protruding edge surface.

30. A piezoelectric micromotor according to any of claims 25-29 wherein the at least one non-piezoelectric layer is formed from a metal.

31. A piezoelectric micromotor according to any of the preceding claims wherein the power supply is capable of electrifying the electrodes to cause motion in a selectively arbitrary direction in the plane of edge surfaces on which the contact surface is located.

32. A method for accelerating or decelerating a moveable body which body is moved by urging a piezoelectric micromotor to the body in a first direction so that a contact region of the piezoelectric motor is pressed to the body and exciting vibrations in the piezoelectric micromotor at the contact region in the first direction and in the direction of motion of the body, said vibrations having a first amplitude in the first direction and a second amplitude in the second direction, the method comprising:

a) for acceleration gradually changing a ratio between the second amplitude relative to the first amplitude from substantially zero to a desired non-zero value; or

b) for deceleration gradually changing the ratio between the second amplitude relative to the first amplitude from a non-zero value to substantially zero.

33. A method according to claim 32 wherein said vibrations in said first direction are excited by providing a first electrification to at least some first electrodes on the piezoelectric motor and wherein said vibrations in said second direction are excited by providing electrification to at least some second electrodes on the piezoelectric motor, at least some of which are different from said first electrodes.

34. A method according to any of claim 33 wherein gradually changing the ratio comprises gradually changing the amplitude of one of the electrifications.

35. A method according to claim 32 wherein first vibrations in the first and second directions are excited by electrifying at least one first electrode on the piezoelectric vibrator and wherein second vibrations in the first and second directions are excited by electrifying at least one second electrode on the piezoelectric vibrator, wherein the phase of the vibrations in the second direction has substantially a 180° phase difference for the first and second vibrations.

36. A method according to claim 35 wherein for accelerating the body, gradually changing the ratio comprises electrifying both said at least one first electrode and said at least one second electrode to cause cancellation of the vibrations in the second direction and gradually reducing electrification of one of the at least one first electrode and at least one second electrode.

37. A method according to claim 35 wherein for decelerating the body, gradually changing the ratio comprises electrifying only one of said at least one first and second electrodes and gradually changing the ratio comprises gradually increasing electrification of the other of the first and second electrodes to cancel vibrations in the second direction.

38. A method according to any of claims 33 - 37 wherein the piezoelectric motor comprises at least one piezoelectric layer and wherein the first and second electrodes are on the same layer.

39. A method according to any of claims 33 - 37 wherein the piezoelectric motor comprises a plurality of piezoelectric layers and wherein the first and second electrodes are on different layers.

40. A method according to claim 32 wherein vibrations in the first direction are excited by applying a voltage to the piezoelectric motor within a first frequency range and wherein vibrations in the second direction are excited by applying a voltage to the piezoelectric motor within a second frequency range which partially overlaps the first frequency range.

41. A method according to claim 40 wherein for accelerating the body gradually changing the ratio comprises comprises applying a voltage at a frequency at which vibrations in

substantially only the first direction are excited and changing the frequency of the voltage to a frequency at which both vibrations in the first and second vibrations are excited.

42. A method according to claim 40 wherein for decelerating the body gradually changing the ratio comprises applying a voltage at a frequency at which both vibrations in the first and second directions are excited and changing the frequency of the voltage to a frequency at which vibrations in substantially only the first direction are excited.

CLAIMS

1. A piezoelectric micromotor for moving a moveable element comprising:

a vibrator in the shape of a rectangular parallelepiped formed from a plurality of thin layers of piezoelectric material having first and second identical relatively large rectangular face surfaces defined by long and short edge surfaces wherein the layers are aligned one on top of the other and have their face surfaces bonded together;

electrodes on surfaces of the layers;

a contact region located on one or more edge surfaces of the layers, urged against the body; and

a least one electrical power supply that electrifies electrodes to excite vibrations in the vibrator and thereby in the contact region that impart motion to the body.

2. A piezoelectric micromotor according to claim 1 wherein the one or more edge surfaces are short edge surfaces of the layers.

3. A piezoelectric micromotor according to claim 1 or claim 2 and including a wear resistant element situated at the contact region for contact with the body.

4. A piezoelectric micromotor according to any of the preceding claims comprising electrodes on face surfaces of the layers that are electrifiable by an AC voltage provided by the power supply to excite elliptical vibrations in the vibrator having a controllable eccentricity.

5. A piezoelectric micromotor according to any of the preceding claims comprising:

a single large electrode on a first face surface of each layer; and

four quadrant electrodes on a second face surface of each layer wherein the quadrant electrodes are arranged in a checkerboard pattern.

6. A piezoelectric micromotor according to any of claims 1-3, comprising:

a single large electrode on a first face surface of each layer; and

a single large electrode on the second face surface of at least one but not all layers;

four quadrant electrodes on the second face surface of at least one layer, wherein the quadrant electrodes are arranged in a checkerboard pattern

7. A piezoelectric micromotor according to claim 5 wherein at least two non-contiguous face surfaces have quadrant electrodes.

8. A piezoelectric micromotor according to claim 5 wherein the at least one power supply electrifies all quadrant electrodes on the second face surface of at least one but not all the layers with a same AC voltage so as to excite longitudinal vibrations in the vibrator and thereby in the contact surface wherein longitudinal vibrations are vibrations parallel to the edges of the layers on which the contact region is situated.

9. A piezoelectric micromotor according to claim 6 wherein the power supply electrifies a large electrode on the second face surface of at least one layer with an AC voltage to excite longitudinal vibrations in the vibrator and thereby in the contact region wherein longitudinal vibrations are vibrations parallel to the edges of the layers on which the contact region is situated.

10. A piezoelectric micromotor according to claim 8 or claim 9 wherein for at least one layer the at least one power supply electrifies a first pair of diagonally disposed quadrant electrodes with a first AC voltage and a second pair of quadrant electrodes along a second diagonal with a second AC voltage and wherein the first and second AC voltages are 180^{o} out of phase and have a same magnitude, so as to excite transverse vibrations in the piezoelectric vibrator wherein transverse vibrations are vibrations parallel to the edges of the layers on which the contact region is situated.

11. A piezoelectric motor according to claim 10 wherein the at least one layer comprises a plurality of layers and wherein homologous electrodes on different layers of the plurality of layers are electrified with the same voltage.

12. A piezoelectric motor according to claim 10 or claim 11 wherein the at least one power source controls magnitudes of AC voltages used to excite longitudinal and transverse vibrations to selectively provide different forms and amplitudes of vibratory motion of the contact region in a plane parallel to the planes of the layers.

13. A piezoelectric motor according to any of claims 10-12 wherein the at least one power source controls phases of AC voltages used to excite longitudinal and transverse vibrations to

selectively provide different forms of vibratory motion of the contact region in a plane parallel to the planes of the layers.

14. A piezoelectric motor according to any of claims 10-13 wherein the at least one power source controls frequencies of AC voltages used to excite longitudinal and transverse vibrations to selectively provide different forms of vibratory motion of the contact region in a plane parallel to the planes of the layers.

15. A piezoelectric micromotor according to any of claims 8-14 wherein for at least one layer the at least one power supply electrifies a first pair of electrodes along a first short edge of the layer and a second pair of quadrant electrodes along a second short edge with first and second AC voltages respectively that are 180° out of phase and have a same magnitude, so as to excite bending vibrations perpendicular to the planes of the layers in the piezoelectric vibrator.

16. A piezoelectric motor according to claim 15 wherein the at least one layer comprises a plurality of layers.

17. A piezoelectric motor according to claim 16 wherein homologous electrodes on layers located on a same side of a face surface inside the vibrator are electrified in phase and homologous electrodes on layers located on opposite sides of the face surface are electrified 180° out of phase.

18. A piezoelectric motor according to claim 15 or claim 17 wherein the at least one power source controls magnitudes of AC voltages used to excite longitudinal and bending vibrations to selectively provide different forms and amplitudes of vibratory motion of the contact region in a plane perpendicular to the planes of the layers.

19. A piezoelectric motor according to any of claims 15-18 wherein the at least one power source controls phases of AC voltages used to excite longitudinal and bending vibrations to selectively provide different forms of vibratory motion of the contact region in a plane perpendicular to the planes of the layers.

20. A piezoelectric motor according to any of claims 15-19 wherein the at least one power source controls frequencies of AC voltages used to excite longitudinal and transverse vibrations to selectively provide different forms of vibratory motion of the contact region in a plane parallel to the planes of the layers.

21. A piezoelectric micromotor according to any of claims 5-20 wherein, for at least one layer, the at least one power supply electrifies a pair of quadrant electrodes that lie along a first diagonal of the layer with an AC voltage while a pair of quadrant electrodes along a second diagonal of the layer are grounded or floating, in order to excite elliptical vibrations in the vibrator.

22. A piezoelectric micromotor according to claim 21 wherein the at least one layer comprises a plurality of layers and wherein homologous electrodes are electrified with the same AC voltage.

23. A piezoelectric motor according to claim 21 or claim 22 wherein the at least one power supply controls the frequency of the AC voltage to selectively control the eccentricity of the elliptical motion.

24. A piezoelectric micromotor according to any of the preceding claims and comprising at least one relatively thin layer of non-piezoelectric material having large rectangular face surfaces defined by long and short edges and relatively narrow long and short edge surfaces.

25. A piezoelectric micromotor according to claim 24 wherein the one of the edges of the at least one non-piezoelectric layer are substantially equal in length to one of the corresponding edges of the piezoelectric layers.

26. A piezoelectric motor according to claim 25 wherein the one edge is a short edge.

27. A piezoelectric micromotor according to claim 25 or claim 26 wherein the other edges of the at least one non-piezoelectric layer are slightly longer than the corresponding other edges of the piezoelectric layers so that at least one edge surface of the non-piezoelectric layer protrudes from the piezoelectric layers.

28. A piezoelectric motor according to claim 27 wherein the other edge is the long edge and wherein at least one short edge surface of the non-piezoelectric layer protrudes from the piezoelectric layers.

29. A piezoelectric micromotor according to claim 27 or claim 28 wherein the contact region comprises a region of one of the at least one protruding edge surface.

30. A piezoelectric micromotor according to any of claims 25-29 wherein the at least one non-piezoelectric layer is formed from a metal.

31. A piezoelectric micromotor according to any of the preceding claims wherein the power supply is capable of electrifying the electrodes to cause motion in a selectively arbitrary direction in the plane of edge surfaces on which the contact surface is located.

32. A method for accelerating a moveable body from rest comprising:

(i) urging a piezoelectric micromotor to the body in a first direction so that a contact region of the piezoelectric motor is pressed to the body;

(ii) exciting vibrations in the piezoelectric micromotor, at the contact region, in the first direction while the body is at rest and the piezoelectric motor is not vibrating in the second direction; and

(iii) thereafter while the piezoelectric micromotor is vibrating in the first direction at the contact region, gradually increasing the amplitude of vibrations, at the contact region, in a second direction perpendicular to the first direction from zero to a desired maximum amplitude.

33. A method according to claim 32 wherein said vibrations in said first direction are excited by providing a first electrification to at least some first electrodes on the piezoelectric motor and wherein said vibrations in said second direction are excited by providing electrification of at least some second electrodes, at least some of which are different from said first set of electrodes.

34. A method according to claim 33 wherein the piezoelectric motor comprises at least one piezoelectric layer and wherein the first and second electrodes are on the same layer.

35. A method according to claim 33 wherein the piezoelectric motor comprises a plurality of piezoelectric layers and wherein the first and second electrodes are on different layers.

36. A method according to any of claims 33-35 wherein gradually increasing the amplitude of vibrations in the second direction comprises gradually increasing the amplitude of the second electrification.

37. A method according to claim 32 wherein vibrations in the first direction are excited by applying a voltage to the piezoelectric motor within a first frequency range and wherein vibrations in the second direction are excited by applying a voltage to the piezoelectric motor within a second frequency range which partially overlaps the first frequency range.

38. A method according to claim 37 wherein:

performing (ii) comprises applying a voltage at a frequency at which only vibrations in the first direction are excited; and

performing (iii) comprises changing the frequency of the voltage to a frequency at which both vibrations in the first and second vibrations are excited.

39. A method according to claim 32 wherein first vibrations in the first and second directions are excited by exciting at least one first electrode and wherein second vibrations in the first and second directions are excited by exciting at least one second electrode, wherein the phase of the vibrations in the second direction has substantially a 180 degree phase difference for the first and second vibrations.

40. A method according to claim 39 wherein:

performing (ii) comprises exciting both said at least one first electrode and said at least one second electrode to cause cancellation of the vibrations in the second direction; and

performing (iii) comprises gradually reducing one of the first and second excitations.

41. A method according to claim 39 or claim 40 wherein the piezoelectric motor comprises at least one piezoelectric layer and wherein the first and second electrodes are on the same layer.

42. A method according to claim 39 or claim 40 wherein the piezoelectric motor comprises a plurality of piezoelectric layers and wherein the first and second electrodes are on different layers.

43. A method of decelerating a moving body being moved, by a piezoelectric micromotor to the body in a first direction so that a contact region of the piezoelectric motor is pressed to the body, in a second direction perpendicular to the first direction, said movement being affected by phased vibrations at the contact region in the first and second directions, the method comprising:

gradually reducing the amplitude of vibrations in the second direction while maintaining the vibrations in the first direction; and

44. A method according to claim 43 wherein said vibrations in said first direction are excited by providing a first electrification to at least some first electrodes on the piezoelectric motor and wherein said vibrations in said second direction are excited by providing electrification of at least some second electrodes, at least some of which are different from said first set of electrodes.

45. A method according to claim 44 wherein gradually decreasing the amplitude of vibrations in the second direction comprises gradually decreasing the amplitude of the second electrification.

46. A method according to claim 44 or claim 45 wherein the piezoelectric motor comprises at least one piezoelectric layer and wherein the first and second electrodes are on the same layer.

47. A method according to claim 44 or claim 45 wherein the piezoelectric motor comprises a plurality of piezoelectric layers and wherein the first and second electrodes are on different layers.

48. A method according to claim 43 wherein vibrations in the first direction are excited by applying a voltage to the piezoelectric motor within a first frequency range and wherein vibrations in the second direction are excited by applying a voltage to the piezoelectric motor within a second frequency range which partially overlaps the first frequency range.

49. A method according to claim 48 wherein:

performing (i) comprises changing the frequency to a frequency at which only vibrations in the first direction are excited.

50. A method according to claim 43 wherein first vibrations in the first and second directions are excited by exciting at least one first electrode and wherein second vibrations in the first and second directions are excited by exciting at least one second electrode, wherein the phase of the vibrations in the second direction has substantially a 180 degree phase difference for the first and second vibrations, wherein said motion is caused by exciting only one of said at least one first and at least one second electrodes.

51. A method according to claim 50 wherein:

performing (i) comprises exciting both said at least one first electrode and said at least one second electrode to cause cancellation of the vibrations in the second direction.

52. A method according to claim 50 or claim 51 wherein the piezoelectric motor comprises at least one piezoelectric layer and wherein the first and second electrodes are on the same layer.

53. A method according to claim 50 or claim 51 wherein the piezoelectric motor comprises a plurality of piezoelectric layers and wherein the first and second electrodes are on different layers.

PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL SEARCH REPORT OR THE DECLARATION

(PCT Rule 44.1)

To:
FENSTER & COMPANY PATENT
ATTORNEYS, LTD
P.O.Box 10256
Petach Tikva 49002
ISRAEL

	Date of mailing *(day/month/year)* 26/01/2000
Applicant's or agent's file reference 013/00975	**FOR FURTHER ACTION** See paragraphs 1 and 4 below
International application No. PCT/IL 99/ 00288	International filing date *(day/month/year)* 31/05/1999
Applicant NANOMOTION LTD. et al.	

1. [X] The applicant is hereby notified that the International Search Report has been established and is transmitted herewith.

Filing of amendments and statement under Article 19:
The applicant is entitled, if he so wishes, to amend the claims of the International Application (see Rule 46):

When? The time limit for filing such amendments is normally 2 months from the date of transmittal of the International Search Report; however, for more details, see the notes on the accompanying sheet.

Where? Directly to the International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland
Fascimile No.: (41-22) 740.14.35

For more detailed instructions, see the notes on the accompanying sheet.

2. [ ] The applicant is hereby notified that no International Search Report will be established and that the declaration under Article 17(2)(a) to that effect is transmitted herewith.

3. [ ] **With regard to the protest** against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:

[ ] the protest together with the decision thereon has been transmitted to the International Bureau together with the applicant's request to forward the texts of both the protest and the decision thereon to the designated Offices.

[ ] no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. **Further action(s):** The applicant is reminded of the following:

Shortly after **18 months** from the priority date, the international application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau as provided in Rules 90*bis*.1 and 90*bis*.3, respectively, before the completion of the technical preparations for international publication.

Within **19 months** from the priority date, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase until 30 months from the priority date (in some Offices even later).

Within **20 months** from the priority date, the applicant must perform the prescribed acts for entry into the national phase before all designated Offices which have not been elected in the demand or in a later election within 19 months from the priority date or could not be elected because they are not bound by Chapter II.

Name and mailing address of the International Searching Authority	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Trudy Thoen-de Jong

Form PCT/ISA/220 (July 1998)

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	**FOR FURTHER ACTION**	see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.
013/00975		
International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/IL 99/ 00288	31/05/1999	
Applicant		
NANOMOTION LTD. et al.		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 2 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

   a. With regard to the **language,** the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

   [ ] the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

   b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

   [ ] contained in the international application in written form.

   [ ] filed together with the international application in computer readable form.

   [ ] furnished subsequently to this Authority in written form.

   [ ] furnished subsequently to this Authority in computer readble form.

   [ ] the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

   [ ] the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. [ ] **Certain claims were found unsearchable** (See Box I).

3. [ ] **Unity of invention is lacking** (see Box II).

4. With regard to the **title,**

   [X] the text is approved as submitted by the applicant.

   [ ] the text has been established by this Authority to read as follows:

5. With regard to the **abstract,**

   [X] the text is approved as submitted by the applicant.

   [ ] the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No. 1a

   [X] as suggested by the applicant.

   [ ] because the applicant failed to suggest a figure.

   [ ] because this figure better characterizes the invention.

   [ ] None of the figures.

INTERNATIONAL SEARCH REPORT

International Application No
PCT/NL 99/00288

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H01L41/09

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H01L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 633 616 A (NANOMOTION LTD) 11 January 1995 (1995-01-11) cited in the application figure 7	1
A	EP 0 536 832 A (PHILIPS PATENTVERWALTUNG ;PHILIPS NV (NL)) 14 April 1993 (1993-04-14) figure 1	1

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

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Date of the actual completion of the international search	Date of mailing of the international search report
19 January 2000	26/01/2000

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Information on patent family members

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